

# RESECTION OF THE STERNUM FOR METASTATIC CARCINOMA\*

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RESECTIONS OF VARIOUS PORTIONS of the sternum have been reported upon several occasions.<sup>1,2</sup> The effects upon the cardiorespiratory systems that accompany instability of this large and important portion of the thoracic wall has limited the indications for its removal to malignant diseases affecting it. In previously reported cases, malignant diseases of the sternum requiring resection have generally been tumors arising primarily within it.<sup>1, 2, 3</sup> Few metastatic lesions in the sternum have been surgically removed.<sup>2</sup> Macey and Phalen,<sup>4</sup> in reporting two lesions of the sternum secondary to primary pulmonary adenocarcinomas, suggest that an attempt should be made to remove such lesions if they have not extended too widely. The usual contraindication is the presence of other osseous or pulmonary metastases.

It is the purpose of this report to describe the successful removal of a malignant tumor of the sternum, metastatic from a previously removed carcinoma of the breast, and the use of a large tantalum plate to restore immobility of this portion of the thoracic wall.

**Case Report.**—E. O., a 58-year-old white female, was admitted July 6, 1945, with a nodule in her right breast of several weeks' duration. Her history and physical examination was not unusual. Roentgenograms of her chest and spine showed no metastases. She was subjected to a right radical mastectomy on July 10, 1945. Subsequent split-thickness skin grafts were required to close the defect over her anterior thoracic wall. Histologic examination of the lesion showed a scirrhous and medullary adenocarcinoma infiltrating mammary fat. No lymph node metastases could be demonstrated.

Examination on January 13, 1948, revealed a 3 x 2 x 1 cm. hard, fixed tumor situated in the midline over the upper portion of the sternum. Roentgenograms of her chest and spine showed no metastases. A biopsy of the tumor showed adenocarcinoma of the same cell type as in the original lesion. Laboratory examinations demonstrated a mild anemia.

**Operation:** On January 31, 1948, under endotracheal nitrous oxide, oxygen, ether anesthesia, an incision was made over the medial one-half of each clavicle and inferiorly down to the xiphoid process, encompassing the tumor, which was located over the manubrium (Fig. 1 inset). Skin flaps were reflected upon either side exposing all the costal cartilages down nearly to the xiphoid process. Following a subperiosteal dissection of the clavicle upon either side, and using a Gigli saw, both clavicles were divided at the junction of the middle and proximal one-third. The first, second, and third ribs upon the right were then exposed subperiosteally and divided at the costochondral junction. The internal mammary vessels upon the right were ligated and divided in the first interspace. The loose fat and areolar tissue of the anterior mediastinum was then carefully dissected from the under surface of the sternum which was divided obliquely, through its body, from the third interspace upon the right to the second interspace upon the left. Both pleural cavities were opened and respiration was carried on with intermittent positive pressure. Following division of the first and second ribs upon the left, the lesion was removed

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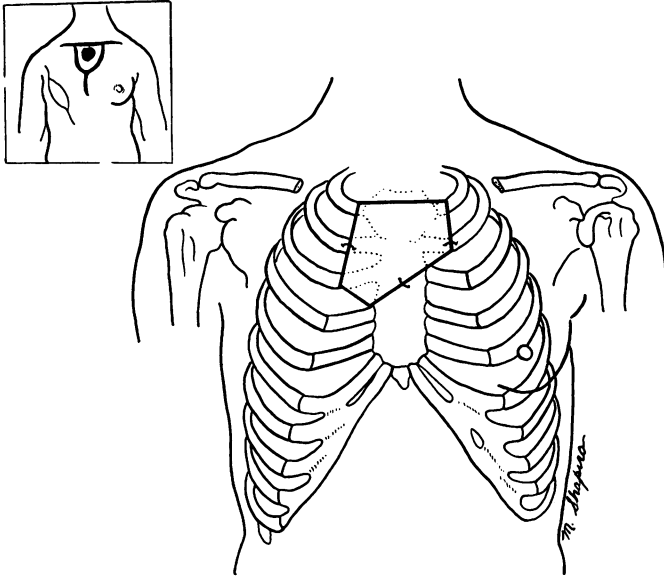


FIG. 1.—Diagram showing amount and location of the resected portion of the sternum and tantalum plate fixed in position.

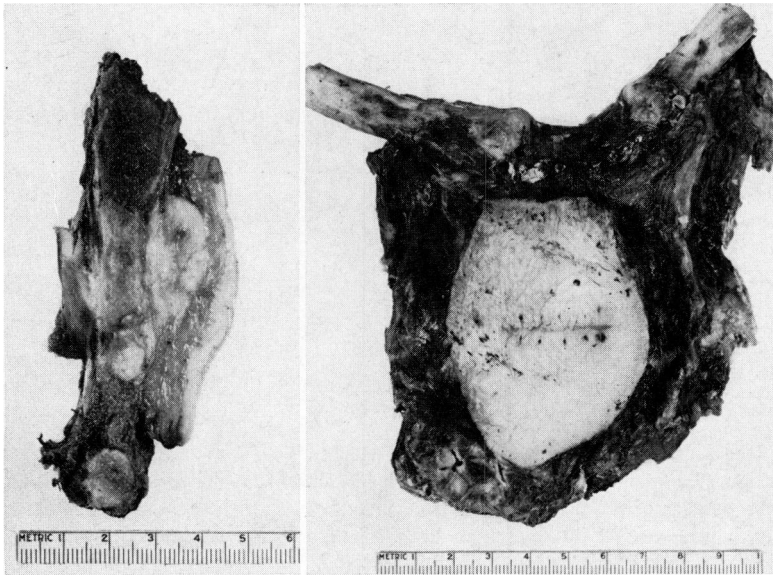


FIG. 2.—Longitudinal and frontal views of removed specimen after fixation in formalin. In the longitudinal view the lesion can be seen to extend completely through the sternum.

together with the proximal one-third of each clavicle, all of the manubrium, and approximately one-half of the body of the sternum (Figs. 1 and 2). The internal mammary vessels upon the left were divided and ligated. The rent in the pleura on the left side was easily closed with interrupted fine cotton sutures. The pleural defect upon the right, however, could not be closed in this manner. Accordingly, a large square of fascia lata was obtained from the right thigh, and sutured securely over the entire exposed anterior superior mediastinum, thus closing the right pleural defect. An intercostal catheter was

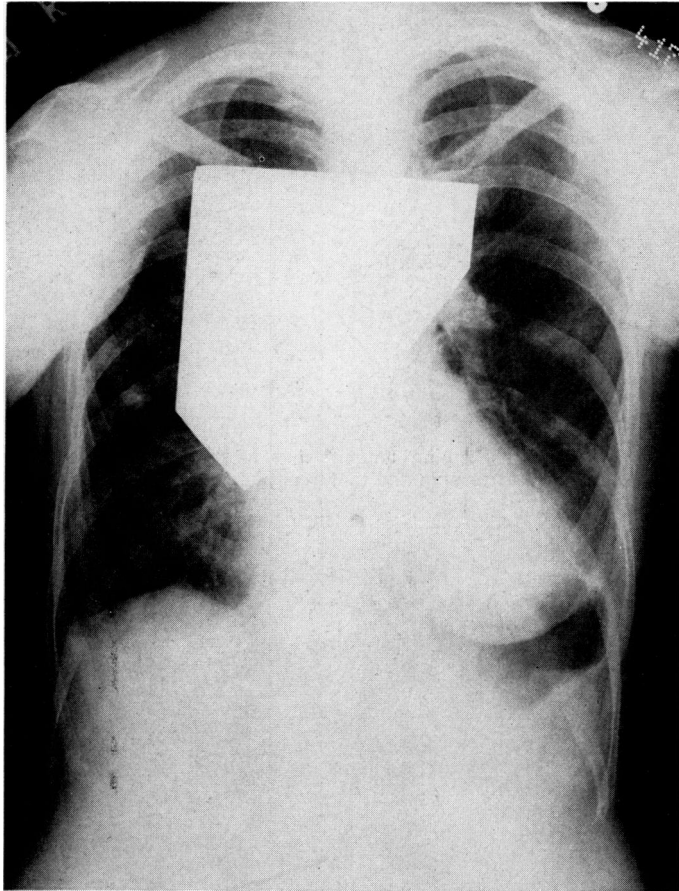


FIG. 3.—Roentgenogram made fourteen weeks following operation showing tantalum plate in position.

left in place in the fourth interspace upon the right. A large tantalum plate, 12.2 cm. wide, 14.0 cm. long, and 0.0375 cm. (0.015 inch) thick was fashioned to fit the bony defect. Each upper corner of the plate was mortised into the end of the first rib upon either side. Similarly, it was wedged into the second rib, but in addition was wired into place, using fine tantalum wire. A third wire fixed the bottom of the plate into the obliquely cut body of the sternum (Fig. 1). The plate, thus, seemed quite secure. The sternocleidomastoid and the sternal attachments of the ribbon muscles of the neck were sutured to the upper aspect of the pectoralis major upon the left, and to the subcutaneous tissue upon the right. Because of the defect in the skin, occasioned by excision of the skin overlying the tumor, it was necessary to rotate a flap of skin and subcutaneous tissue from the left side. The skin and subcutaneous tissue was closed in two layers with fine No. 60 cotton. Penrose

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drains were left under the skin for 48 hours. The patient received 1500 cc. of whole blood during the procedure.

*Postoperative Course.* Her convalescence was quite uneventful. Small hematmata were aspirated from beneath the skin occasionally for three weeks, following which the wound appeared to be well healed with no evidence of an accumulation of serum or blood beneath the skin or plate. Forcible respiration does not buckle the plate. At the date of this writing, the plate remains securely in place eight months after operation, and causes no discomfort to the patient. There is no evidence of other local or distant metastases.

*Comment:* The surgical removal of metastatic carcinoma anywhere in the body must be considered a palliative procedure. Occasionally, however, such lesions appear to be unaccompanied by similar ones and the patient may survive for many years.<sup>5, 6</sup> However, the prediction cannot be made that such a fortunate recovery will occur in any specific instance. The selection of cases

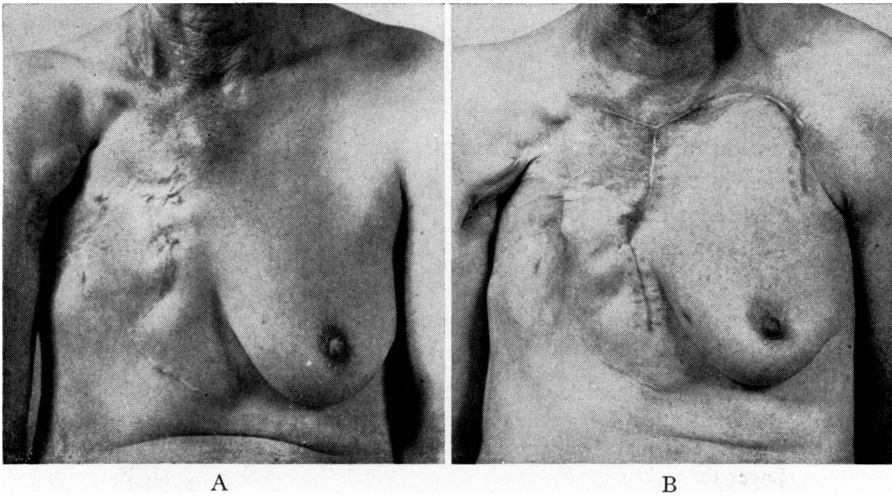


FIG. 4.—A. Before operation showing site of metastatic lesion. B. Photograph taken approximately five months after operation.

for removal of isolated metastases can only be made after determining that a) the general condition of the patient is good, b) there is no evidence of other metastases in the same or other systems, and that c) the lesion can be completely removed by a procedure unaccompanied by a prohibitive mortality.

Tantalum, a metal proven to be inert in human tissues, has recently received attention in the repair of bony defects, chiefly in the skull.<sup>9, 10</sup> In addition, it has been used as wire, wire mesh, and tubes for arterial anastomoses. Paulson<sup>7</sup> has used tantalum plates to cover chest wall defects but abandoned the method because of difficulty encountered in immobilizing the plate on a constantly moving structure such as the thorax. Griswold,<sup>8</sup> in 1947, reported the successful temporary use of a tantalum plate as a prosthesis following resection of the body of the sternum for an osteochondrosarcoma. He found it necessary to remove it approximately two and one-half months later because of recurring hematmata. Griswold concluded that the method was a satisfactory procedure for a temporary readjustment period following operation.

A review of some anatomic facts may explain the successful use of the tan-

talum plate in the case reported. 1. There is no motion between the first rib and the manubrium for a joint does not exist at this point. 2. The second to the seventh ribs, inclusive, articulate directly with the sternum by means of true joints lined with synovial membranes. 3. The seventh to the ninth ribs move between each other by means of interchondral articulations, but are anchored to the sternum through the sixth and seventh costal cartilages. Thus, it is seen that the removal of the upper one-half of the sternum requires the sacrifice of only a few joints (in the case reported, three) and fixation of the ribs and sternum to a metal plate is correspondingly easier. On the other hand, the substitution of a metal plate for the lower one-half of the sternum requires it to be an anchoring post for twelve or fourteen ribs. Complications incident to motion of so many ribs upon a metal plate are easily understood. Such a plate substituting for a portion of the sternum should probably then be limited to the superior portion of this structure, unless it is to be used, as Griswold suggests, as a prosthesis for a temporary postoperative period of readjustment.

## SUMMARY

1. Resection of the sternum for metastatic carcinoma in carefully selected cases is a feasible procedure.
2. The use of a tantalum plate as a permanent prosthesis is more likely to be successful as a substitution for the upper one-half of the sternum than for the lower one-half.
3. A case is reported in which such a procedure was successfully accomplished.

ADDENDUM: Since this article was submitted for publication, this patient has been seen monthly in the Out-Patient Department. She was hospitalized for 12 days during October, 1948, at which time a small two-inch full thickness flap of skin and subcutaneous tissue was rotated over the right edge of the plate. She was last seen January 25, 1949, one year after operation, at which time there was no evidence of recurrence or metastases and the prosthesis was solidly in place.

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